ORIGINAL ARTICLE

# Predictors of acute cervicouterine angulation in patients scheduled for gynaecological or infertility intrauterine office procedures

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Abstract The purpose behind this observational study was to find whether age, parity, ethnicity, uterine position or the mode of presentation (infertility or gynaecological) could be used to predict acute cervicouterine angulation (ACUA) before intrauterine office surgical procedures. Uterine version, flexion and ACUA were recorded after transvaginal scanning in 914 patients and during subsequent examinations in a subgroup of 422 patients. ACUA was tested against presentation, age, parity, ethnicity and uterine position using chi-square and logistic regression. A two-tailed p value <0.05 was considered significant. One hundred and forty-two of 667 nulliparous (21.30%) and 23 of 247 (9.3%) parous women showed ACUA (p <0.001), which persisted during repeated examinations. More patients with anteflexed (153/767, 19.9%) than retroflexed uteri (12/147, 8.2%) had ACUA p<0.001. It was more common in Afro-Caribbean (39/179, 21.8%) and Middle East women (37/129, 28.7%) than Caucasians (89/606, 14.7%; p=0.001). Age and presentation were not significant. Accordingly, ACUA should be considered before office intrauterine surgical procedures in nulliparous

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London N6 4DJ, UK patients, especially those with anteflexed uteri. We debate the clinical implications of ethnicity.

**Keyword** Cervicouterine angulation · Uterine instrumentations · Office procedures

### Introduction

Office gynaecological procedures and single stop gynaecology clinics are becoming very popular, especially in dealing with abnormal uterine bleeding using diagnostic and operative hysteroscopy, the mirena system and endometrial ablation techniques. It is noticeable that there are no guidelines to perform transvaginal ultrasound scanning before such procedures, to check for acute anteflexion or retroflexion of the uterus. In fact, the instruction sheets for intrauterine contraceptive device (IUCD) insertion recommend bimanual pelvic examination to identify the direction of the uterus. Unfortunately, the direction of the cervical canal is hardly documented or reported even in patients who had ultrasound scan examinations. Difficulty might be encountered during intrauterine instrumentation, secondary to acute angulation of the cervicouterine angle, which could lead to pain, failure of the procedure or even uterine perforation. On the fertility side, difficult embryo transfer has been associated with lower pregnancy rates after assisted reproduction treatment [1-3]. Such difficulty could be due to different causes including acute anteflexion or retroflexion of the uterus [4]. Such acute angulation might not be corrected by having a full bladder, especially if the body of the uterus is acutely retroflexed. Using a tenaculum to straighten the cervical canal should be avoided as it could trigger uterine contractions [5]. In such cases, a stylet would be needed to facilitate embryo transfer (ET) under



Fig. 1 Rendered coronal view of a uterus with ACUA. Both the cervical os (full of mucous) and the fundus pointed forward with an acute angle in between. It depicts the position of a retroverted anteflexed uterus with the patient in the lithotomy position. It also gives better perception of how a hysteroscope or an IUCD applicator has to travel backwards along the cervical canal before passing forwards at the acute angle to enter the uterine cavity. The exact junctional zone is seen as a dark area as it falls within a different plane compared to the lower cervical canal and upper part of the body of the uterus

ultrasound control. However, elective ET under ultrasound guidance has not been adopted as a universal practice. Many units still perform clinical touch ET and resort to ultrasound only after an initial difficulty. Furthermore, dummy embryo transfer is not a universal practice in all units. Many authors documented superior pregnancy rates after ultrasound-guided ET [6–9], whereas others did not confirm such an effect [10–12]. On the other hand, Lambers et al. [13] showed no difference in implantation or pregnancy rates between ultrasound-guided ET and ET performed after ultrasonic pre-measurement of the uterine cavity.

The terms anteverted and retroverted relate to forward and backward direction of the long axis of the cervical canal in relation to the long axis of the patient's body. On the other hand, anteflexion and retroflexion relate the long axis of the body of the uterus to the long axis of the cervical canal. An anteflexed uterus would lean forward, and a retroflexed one would lean backward in relation to the cervix, irrespective of the cervix being anteverted or retroverted. Contrary to the common impression that anteflexion is usually combined with anteversion; this was not the case in 20.3% of the patients who also showed acute cervicouterine angulation [14]. On the other hand, the same author showed that retroflexion of the uterus was nearly always associated with retroversion. However, the terms version and flexion are commonly erroneously interchanged. Anteversion or retroversion is commonly used to indicate a forward or backward leaning uterus, respectively, during reporting of clinical and ultrasound scan examinations. As mentioned before, the direction of the cervix is hardly documented, which would reduce the practical value of such reporting in identifying cases with acute cervicouterine angulation.

The idea behind this observational study was instigated by such erroneous reporting and the frequent difficulties caused by acute anteflextion or retroflexion of the uterus, with a cervicouterine angle of <90°, during office gynaecological or infertility procedures. In such cases, difficulty is usually encountered in having a sagittal view of the uterus and the whole length of the cervix in the same longitudinal plane during transvaginal ultrasound scanning (Figs. 1 and 2). Gentle movement of the probe in different directions might be needed to see different parts of the cervix in relation to the long axis of the body of the uterus. Our objectives were to establish the common uterine positioning within the pelvis and the prevalence of ACUA, with an angle <90°, in women presenting with gynaecological or infertility problems in relation to their age, ethnic origin, and previous parity. The ultimate objective was to find if one or a group of these parameters could be used to identify patients at greater risk of having ACUA, which might lead to difficult uterine cannulation during gynaecological or infertility procedures. This would help in selecting patients for office hysteroscopic examination or other office procedures including IUCD insertion under sedation or even general anaesthesia. It could also help in identifying patients for dummy embryo transfer or actual embryo transfer under ultrasound guidance in units where such procedures are not performed as a routine. Alternatively, the exact angulation and curvature could be measured [15] and recorded in the notes. All this information together with the corresponding ultrasound pictures could be used as a road map during any future intrauterine cannulation procedure. Such information could not be produced by blind probing



Fig. 2 Oblique longitudinal view of an anteverted retroflexed uterus with acute angulation of the cervicouterine junction. Both the cervical canal and uterine cavity are marked with *multiple arrows*. This picture, with the oblique rotation, was the best possible to demonstrate the maximum length of both organs in the same plane with a good impression of the acute angulation in between the two

or sounding of the uterus, which could be uncomfortable as well. We are not aware of a similar study after a thorough search of the literature.

#### Materials and methods

Nine hundred and fourteen patients between the ages of 18 and 40 years who required pelvic ultrasound scan examination for different gynaecological or infertility problems were included in this study. None of the patients was pregnant at the time of examination. The study was approved by the clinic committee. Following consent, transvaginal scan examination was performed in the lithotomy position with an empty bladder using a Kretz Voluson 730 ultrasound machine with a 5-MHz vaginal probe (GE Kretz Ultrasound, Tiefenbach 15, 4871 Zipf, Austria). During this basic session, a thorough examination of the cervix, uterus, ovaries, and pouch of Douglas was done as part of the diagnostic workup of the patients' problems. A fixed protocol was used to diagnose uterine version, flexion and ACUA. The cervix was identified first as soon as the probe was inserted into the vagina, and the direction of the cervical canal was ascertained. The direction of the lower part of the cervix in relation to the long axis of the patient's body was used as a denominator for diagnosing anteversion and retroversion. The uterus was considered to be anteverted when the lower cervix pointed backward towards the rectum and retroverted when it pointed forward towards the bladder. Uterine flexion was diagnosed according to the direction of the body of the uterus in relation to the long axis of the cervical canal. Anteflexion and retroflexion were diagnosed when the body of the uterus pointed forward or backward relative to the cervical canal, respectively. Patients were divided into four groups. Group A had anteverted anteflexed, group B retroverted retroflexed, group C retroverted anteflexed and group D anteverted retroflexed uterine configuration. ACUA was diagnosed when the long axis of the cervical canal and the body of the uterus met at an angle  $<90^{\circ}$ . All the scans were performed by the first author. A subgroup of 422 patients had one or more further scans during the period of the study. During each examination, the exact uterine flexion, version and cervicouterine angulation were rechecked against the initial examination. The presence of ACUA was analysed in relation to the mode of presentation whether infertility or gynaecological cause, age, parity, ethnic origin and uterine anteflexion or retroflexion. Version 17 of the statistical package for social sciences (SPSS) was used for data analysis. Cross-tabulation with chi-square and logistic regression were used for statistical analysis. A twotailed *p* value <0.05 was taken as significant.

# Results

The uterus was anteverted and anteflexed in 614 (67.2%) patients (group A), and 135 women (14.8%) had a retroverted and retroflexed uterus (group B). These are the two forms usually reported as anteverted and retroverted uteri, respectively. However, ACUA was seen in 153 (16.7%) cases as a retroverted anteflexed configuration (group C, Fig. 1) and 12 (1.3%) anteverted retroflexed uteri (group D, Fig. 2). Accordingly, ACUA was seen in 18.1% of the whole group examined, a pattern that persisted during the 422 repeated ultrasound examinations. Furthermore, in this study, ACUA was more common when the body of the uterus was anteflexed (153/767, 19.9%) and easier to feel with the abdominal hand during bimanual pelvic examination than when the uterus was retroflexed (12/147, 8.2%; p < 0.001), with an odd ratio of 2.8. Without documenting the long axis of the cervix, patients in groups C and D would have been erroneously considered to belong to groups A and B, respectively. This would have given a diagnostic error of 18.1% (165/914) in the whole group. Despite the persistence of the acute angulation of the body of the uterus in its forward or backward direction relative to the cervical canal in all cases diagnosed with ACUA, changes in the direction of the cervical canal itself relative to the long axis of the patient's body were seen in five out of the 422 patients (1.1%) during the repeated scan examinations. All five patients were parous.

Table 1 shows that ACUA was not related to age but was more frequent in nulligravid and nulliparous women in comparison to patients who had conceived or delivered at least once before, respectively. In mathematical terms, one

**Table 1** The number and<br/>percentage of women with acute<br/>cervicouterine angulation<br/>(ACUA) and the statistical<br/>differences between the<br/>different groups

Patients group	s group ACUA Patients group		ACUA	p value	
Women <35 years old	119/616 (19.3%)	Women ≥35 years old	46/298 (15.4%)	0.169	
Previously pregnant	53/416 (12.7%)	Nulligravid patients	112/498 (22.5%)	< 0.001	
Parous women	23/247 (09.3%)	Nulliparous women	142/667 (21.3%)	< 0.001	
Parous women	23/247 (09.3%)	Unsuccessful pregnancy	30/169 (17.8%)	0.016	
Unsuccessful pregnancy	30/169 (17.8%)	Nulligravid patients	112/498 (22.5%)	0.231	
Normal delivery	15/196 (07.7%)	Caesarean section	08/51 (15.7%)	0.102	

**Table 2** The number and per-<br/>centage of patients with ACUA<br/>and the statistical differences<br/>between the different ethnic<br/>groups studied in relation to age,<br/>previous pregnancy and parity

Patients group	Whites	Afro-Caribbean	Middle East	p value
Total group	89/606 (14.7%)	39/179 (21.8%)	37/129 (28.8%)	0.001
Women <35 years old	67/415 (16.1%)	27/108 (25.0%)	25/93 (26.9%)	0.016
Women ≥35 years old	22/191 (11.5%)	12/71 (16.9%)	12/36 (33.3%)	0.004
Nulligravid patients	68/362 (18.8%)	18/57 (31.6%)	26/79 (32.9%)	0.005
Previous pregnancy	21/244 (08.6%)	21/122 (17.2%)	11/50 (22.0%)	0.007
Nulliparous women	79/466 (17.0%)	29/98 (29.6%)	34/103 (33.0%)	< 0.001
Parous women	10/140 (07.1%)	10/81 (12.3%)	03/26 (11.5%)	0.403

in five nulliparous women had ACUA compared to one in 11 patients in the parous group. Furthermore, a significant difference was seen between parous women and those who had unsuccessful pregnancies but not between the latter group and nulligravid patients. At the same time, there was no difference in the number of patients with ACUA who had caesarean section or vaginal deliveries. The main theme of this table is that ACUA was more common in nulliparous women.

Table 2, on the other hand, shows that ACUA was least common in Caucasian women compared to the other two ethnic groups. This effect was seen across both age groups studied and in nulligravid, nulliparous and even in those who conceived at least once before. However, previous childbirth cancelled this pattern, as no difference could be seen in the number of parous women with ACUA in the different ethnic groups. There was no difference between the two non-Caucasian groups in the total (p=0.182), nulliparous (p=0.650) or parous groups (p=1.00). The main theme of this table is that ACUA was more common in non-Caucasian nulliparous women.

The effect of parity was also important in patients who presented with infertility or gynaecological problems. More infertile women had ACUA (89/413, 21.5%) compared to women who presented with gynaecological problems (76/501, 15.2%, p=0.015), in the whole group. Controlling for parity, the figures for parous infertile women (9/104, 8.7%) were not significantly different from those related to parous women with gynaecological problems (14/143, 9.8%, p=0.827).

Logistic regression analysis of the four risk factors, which had some effect on ACUA, generated a model shown in Table 3. It revealed that parity had the highest Wald chi-square, followed by ethnicity and uterine flexion. The mode of presentation whether gynaecological or infertility had the lowest Wald chi-square and a nonsignificant p value. We then examined the combined effects of the three other predictive covariants with significant statistics. Nulliparous Caucasian women with an anteflexed uterus (77/414, 18.6%) had an odd ratio of 5.9 for having ACUA compared to their counterparts with a retroflexed uterus (2/54, 3.7%; p=0.003). In mathematical terms one in five nulliparous Caucasian women with anteflexed uteri would have ACUA compared to one in 27 in cases with uterine retroflexion. For non-Caucasian patients, the corresponding odd ratio was 6.4. ACUA was seen in 60 of 163 (36.8%) nulliparous women with uterine anteflexion and three of 36 (8.3%) patients with retroflexion (p < 0.001). Accordingly, one in 2.7 women with anteflexion and one in 12 with retroflexion would show ACUA, respectively, in the non-Caucasian nulliparous groups.

#### Discussion

Our results agreed with those of Bernaschek [14] regarding the percentage of women in the general group who had acute uterine angulation with anteflexion. Accordingly,

В	SE	Wald	df	Significance	Exp(B)	
-0.220	0.187	1.387	1	0.239	0s.803	
-1.035	0.246	17.686	1	0.000	0.355	
-0.759	0.192	15.669	1	0.000	0.468	
-1.033	0.321	10.375	1	0.001	0.356	
-0.588	0.161	13.417	1	0.000	0.555	
	B -0.220 -1.035 -0.759 -1.033 -0.588	B         SE           -0.220         0.187           -1.035         0.246           -0.759         0.192           -1.033         0.321           -0.588         0.161	B         SE         Wald           -0.220         0.187         1.387           -1.035         0.246         17.686           -0.759         0.192         15.669           -1.033         0.321         10.375           -0.588         0.161         13.417	B         SE         Wald         df           -0.220         0.187         1.387         1           -1.035         0.246         17.686         1           -0.759         0.192         15.669         1           -1.033         0.321         10.375         1           -0.588         0.161         13.417         1	B         SE         Wald         df         Significance           -0.220         0.187         1.387         1         0.239           -1.035         0.246         17.686         1         0.000           -0.759         0.192         15.669         1         0.000           -1.033         0.321         10.375         1         0.001           -0.588         0.161         13.417         1         0.000	

 Table 3 The data generated in a logistic regression model using the option Enter

The highest Wald statistics value is shown by parity, followed by ethnic origin and then uterine flexion. All three covariants showed very highly significant p values. Presentation showed the lowest Wald value with non significant p value. Accordingly, it should not be used as a predictive covariant in this model. Significance: two-tailed p value

B estimated log odd ratio, SE standard error, Wald Wald chi-square value, df degree of freedom, Exp(B) exponential of B

feeling the uterus with the abdominal hand during bimanual pelvic examination, before intrauterine office procedures, does not exclude the possibility of such acute angulation. It might even be a significant risk factor in nulliparous women, as shown by logistic regression analysis in this study. However, we managed to show that retroflexion was not associated with retroversion in all cases, in contradiction to what was reported by Bernaschek [14]. Of the patients with retroflexion, 8.2% had anteversion, with acute angulation, instead. An important observation was that none of the patients in group A or B had ACUA. This indicated that there was no case of acute angled anteflexion of the body of the uterus with anteversion of the cervix or acute uterine body retroflexion with cervical retroversion in this study.

A typical example of a patient predisposed to ACUA would be a nulliparous woman of non-Caucasian origin with an anteflexed uterus. We included ethnic origin as a study parameter, as thicker levator ani muscles [16], smaller total pelvic floor area [17], closer puborectalis attachment [18] and smaller sacral angulation with larger lumbosacral curvature [19] have been reported in Afro-Caribbean compared to White women. Such pelvic musculoskeletal anatomical differences might have some biomechanical bearing on the positioning and motility of the uterus and cervix within the pelvis. The higher prevalence of ACUA in Afro-Caribbean women compared to Caucasians, as shown in this study, added one further pelvic anatomical difference between the two ethnic groups.

As the effect of parity/nulliparity had the highest Wald chi-square among the covariants and multiparous women showed the least likelihood to have ACUA, we got interested in finding whether it was the distension of the uterus during the third trimester or the biomechanics of labour itself was the important factor in this respect. The lack of any significant difference between parous women who had natural or caesarean deliveries suggested that distension of the uterus in late pregnancy and development of the lower uterine segment were more important than the mode of delivery in relation to the presence or absence of ACUA.

We also showed that ACUA was a persistent finding during repeated transvaginal scan examinations. Accordingly, a single examination could be used to document acute cervicouterine angulation, its direction and curvature without the need for repeated examinations. Such information could be documented in the patients' notes to be used with the corresponding ultrasound pictures as a road map for future intrauterine procedures. On the other hand, retroversion or anteversion could vary at different times, and the percentage of women who might show such variations could be higher in older women and those with higher parity than the study group included in this report. This could be expected as movement of the cervix depends mainly on the tensile strength of the ligaments holding it in position. Laxity of such ligaments could allow movement of the cervix in different directions

# Conclusion

The risk of acute cervicouterine angulation is higher in nulliparous women. Easy palpation of the body of the uterus with the abdominal hand during bimanual pelvic examination before intrauterine office procedures does not exclude this possibility, especially in a nulliparous patient. Ideally such acute angulation, its direction and curvature should be ascertained or excluded in all patients with transvaginal scan examination before such procedures. With limited resources, such service should be directed towards all nulliparous patients irrespective of ethnic origin, despite the statistical differences shown in this study. Still, one in five Caucasian nulliparous women with anteflexed uteri showed such acute angulation. This is particularly important in units where ultrasound-guided ET is not performed routinely. Furthermore, patients with such acute cervicouterine angulation could be scheduled in advance for hysteroscopic examination or IUCD insertion by an experienced operator under sedation or even general anaesthesia.

**Conflict of interest** There is no actual or potential conflict of interest in relation to this article.

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